OTRE WP21
JUL 13 2006
PATENT & TRADEMARK OFFICE

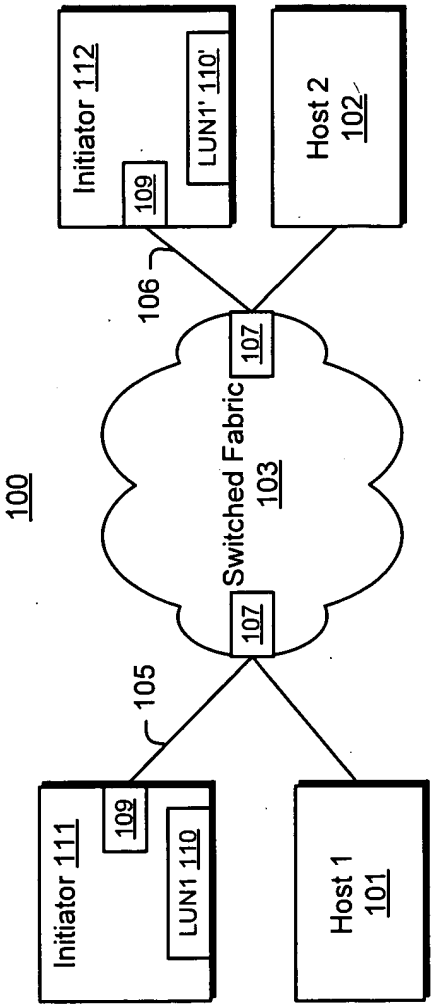


Fig. 1

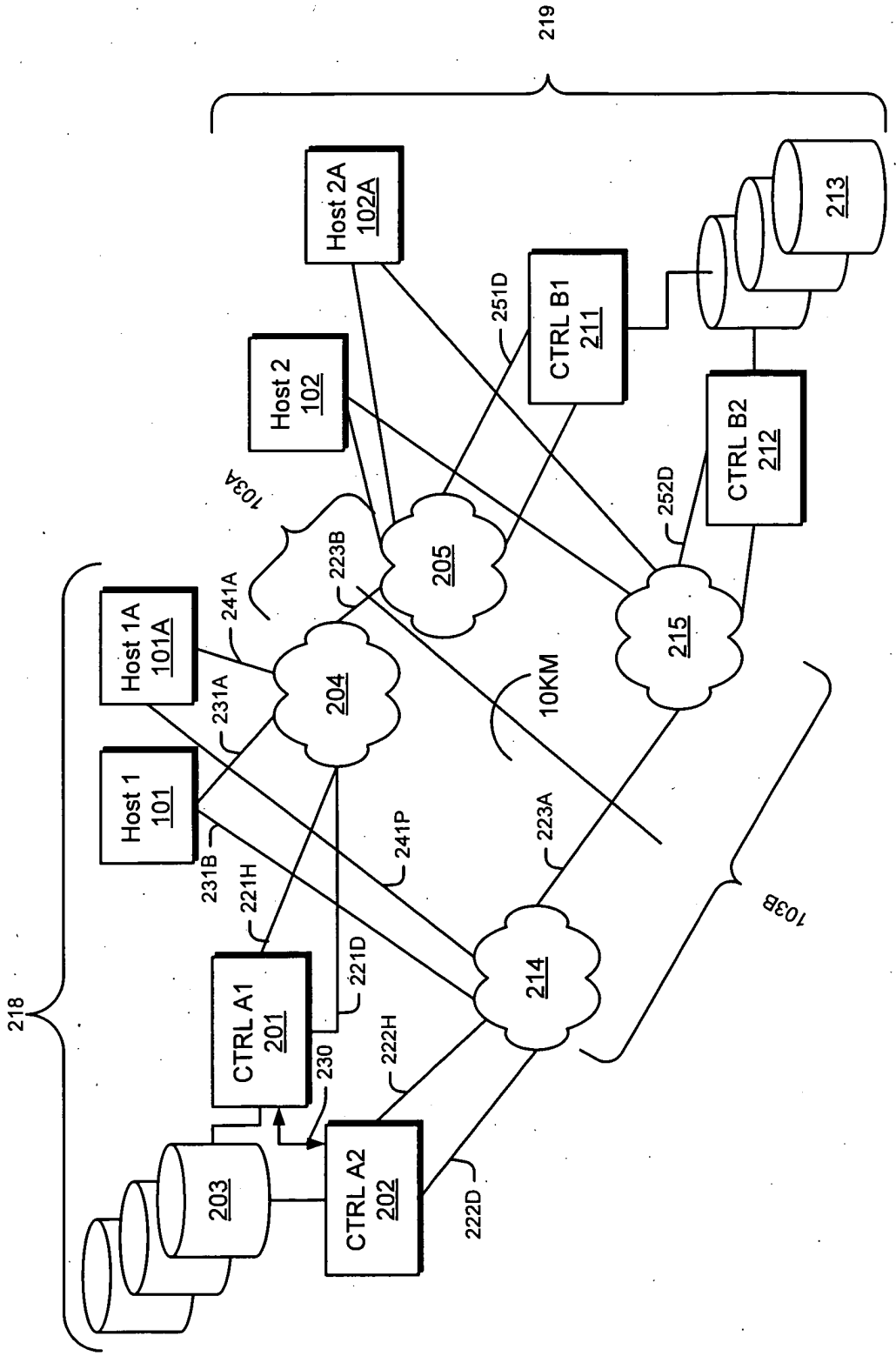

219
Host 2A 102A
Host 2 102
Host 1A 101A
Host 1 101
CTRL A1 201
CTRL A2 202
CTRL B1 211
CTRL B2 212
213
203
205
204
215
214
218
103A
103B
10KM
251D
252D
241A
241P
231A
231B
223B
223A
221H
221D
222H
222D
230

Fig. 2

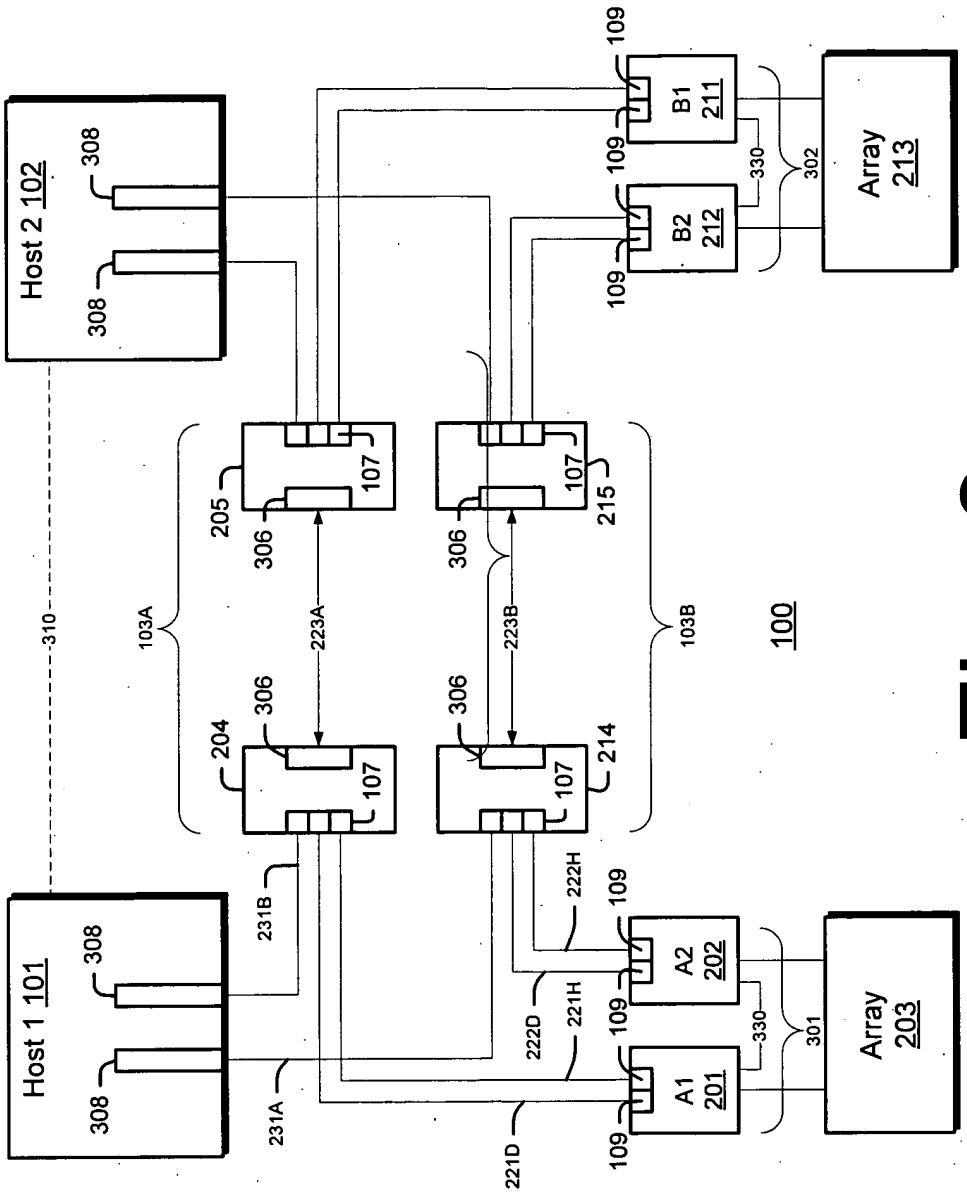

Host 2 102
Host 1 101
308
310
B1 211
B2 212
A2 202
A1 201
Array 213
Array 203
109
330
302
301
205
215
204
214
107
306
103A
103B
223A
223B
231B
231A
222H
222D
221H
221D
100

Fig. 3

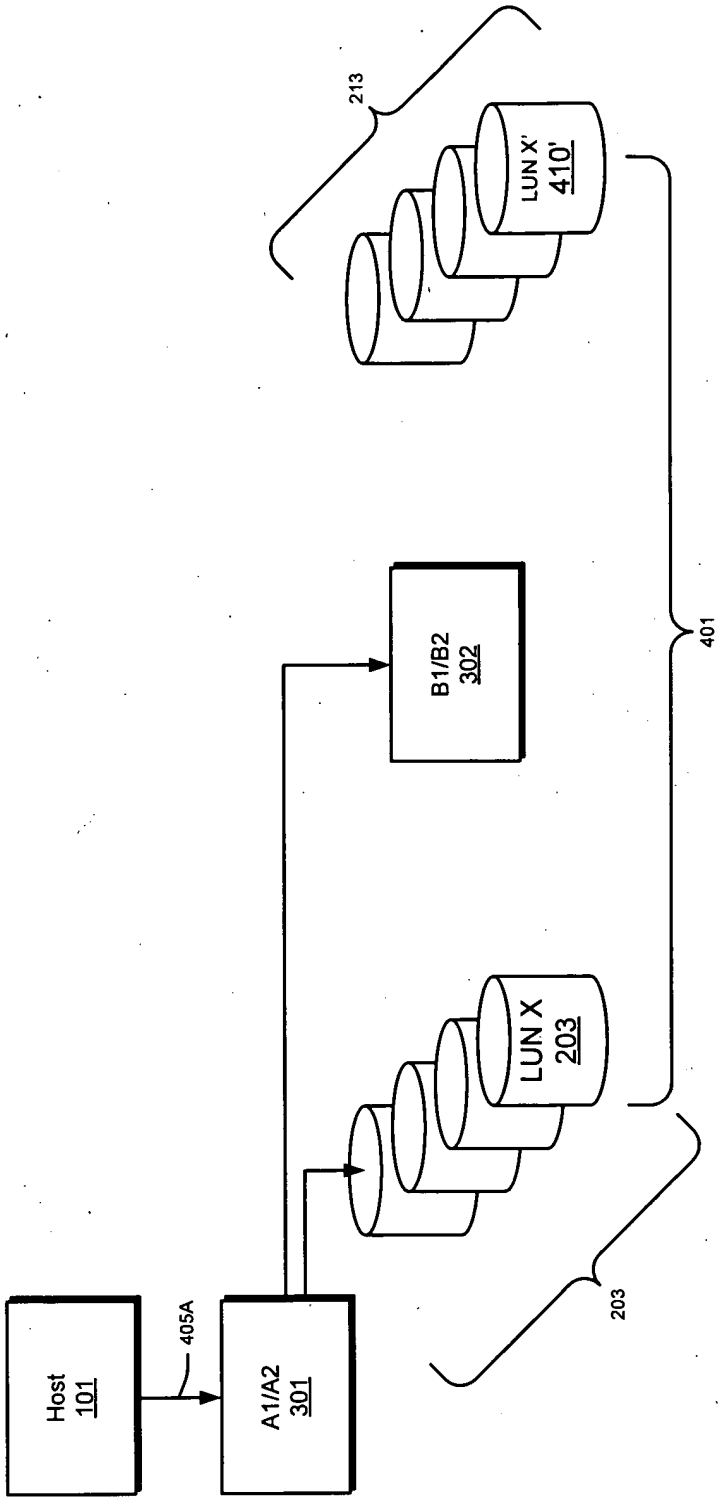


Fig. 4

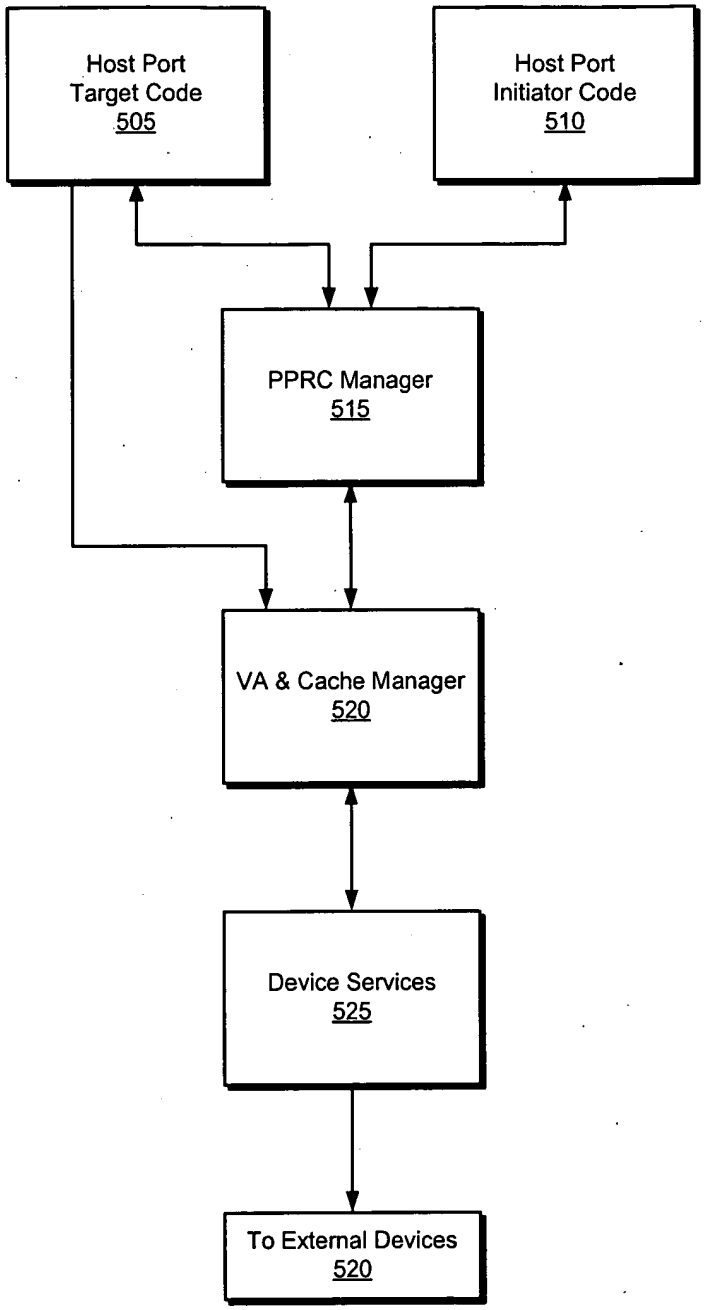

Host Port
Target Code
505
Host Port
Initiator Code
510
PPRC Manager
515
VA & Cache Manager
520
Device Services
525
To External Devices
520

Fig. 5

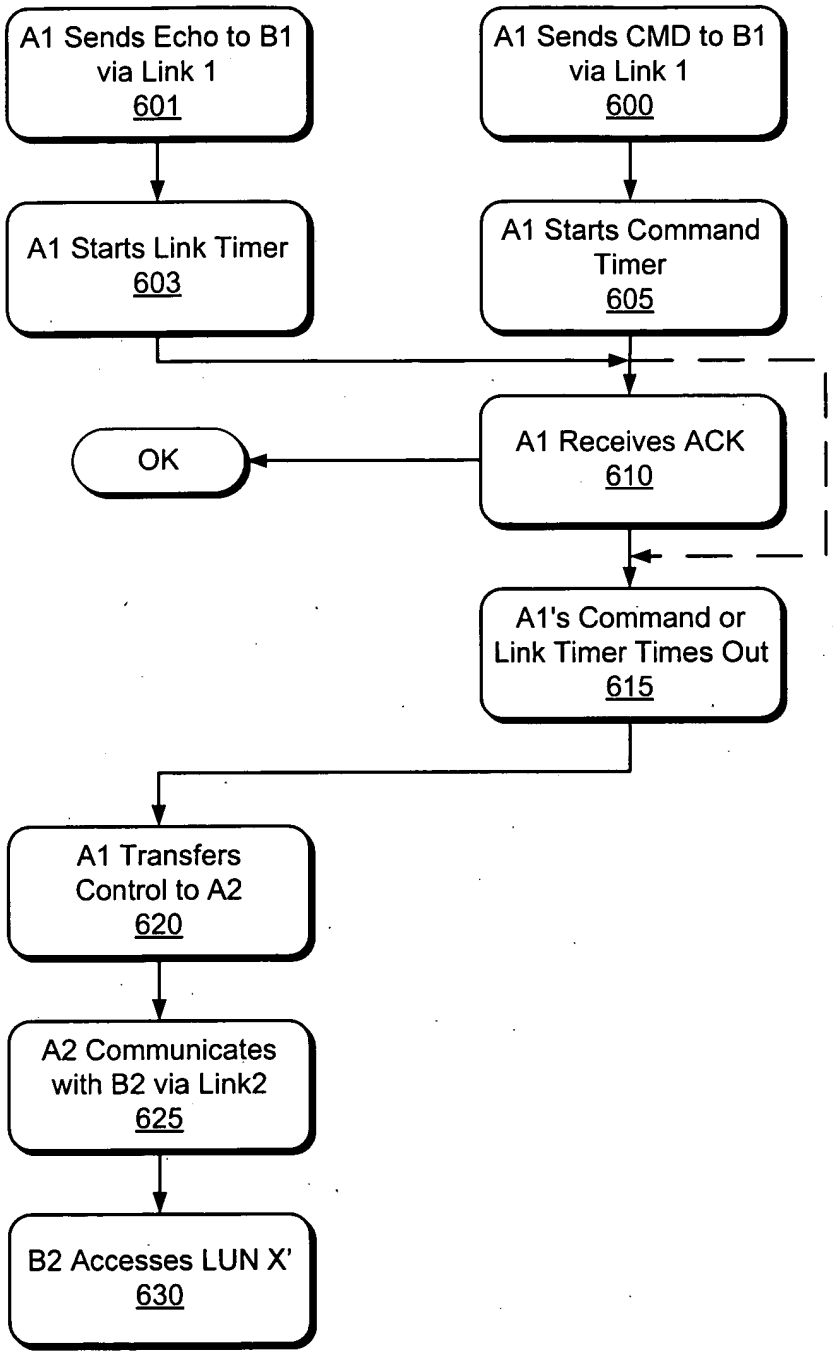

A1 Sends Echo to B1 via Link 1
601
A1 Sends CMD to B1 via Link 1
600
A1 Starts Link Timer
603
A1 Starts Command Timer
605
OK
A1 Receives ACK
610
A1's Command or Link Timer Times Out
615
A1 Transfers Control to A2
620
A2 Communicates with B2 via Link2
625
B2 Accesses LUN X'
630

Fig. 6A

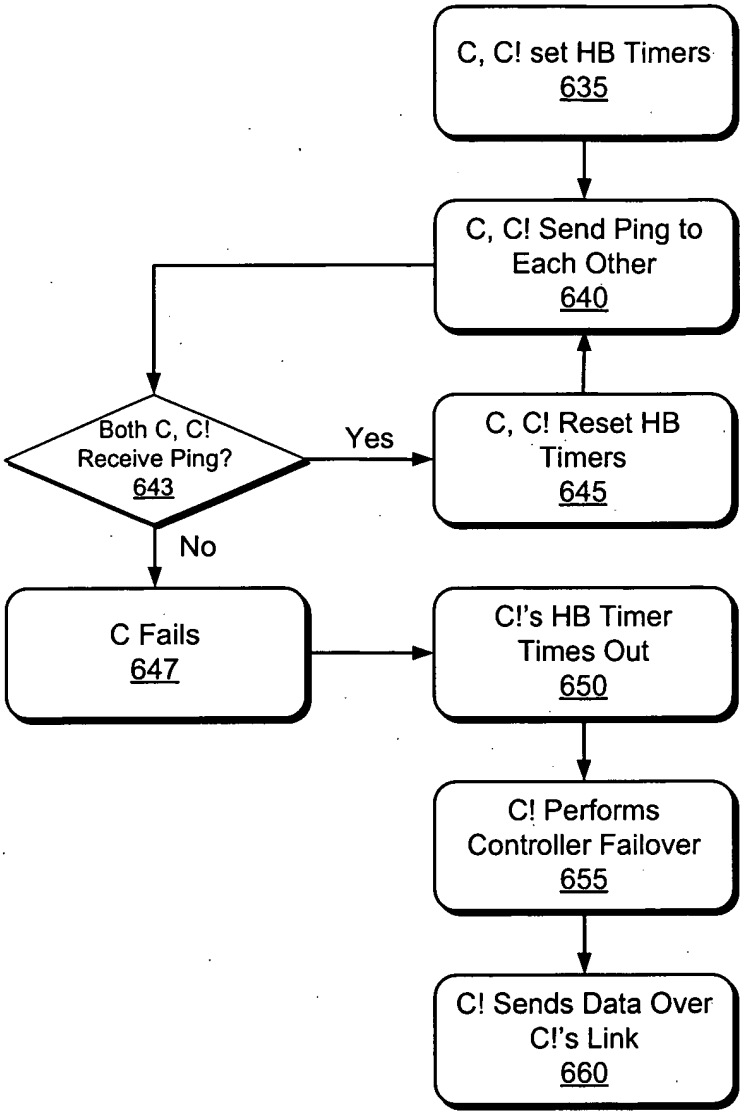

C, C! set HB Timers
635
C, C! Send Ping to Each Other
640
Both C, C! Receive Ping?
643
Yes
C, C! Reset HB Timers
645
No
C Fails
647
C!'s HB Timer Times Out
650
C! Performs Controller Failover
655
C! Sends Data Over C!'s Link
660

Fig. 6B

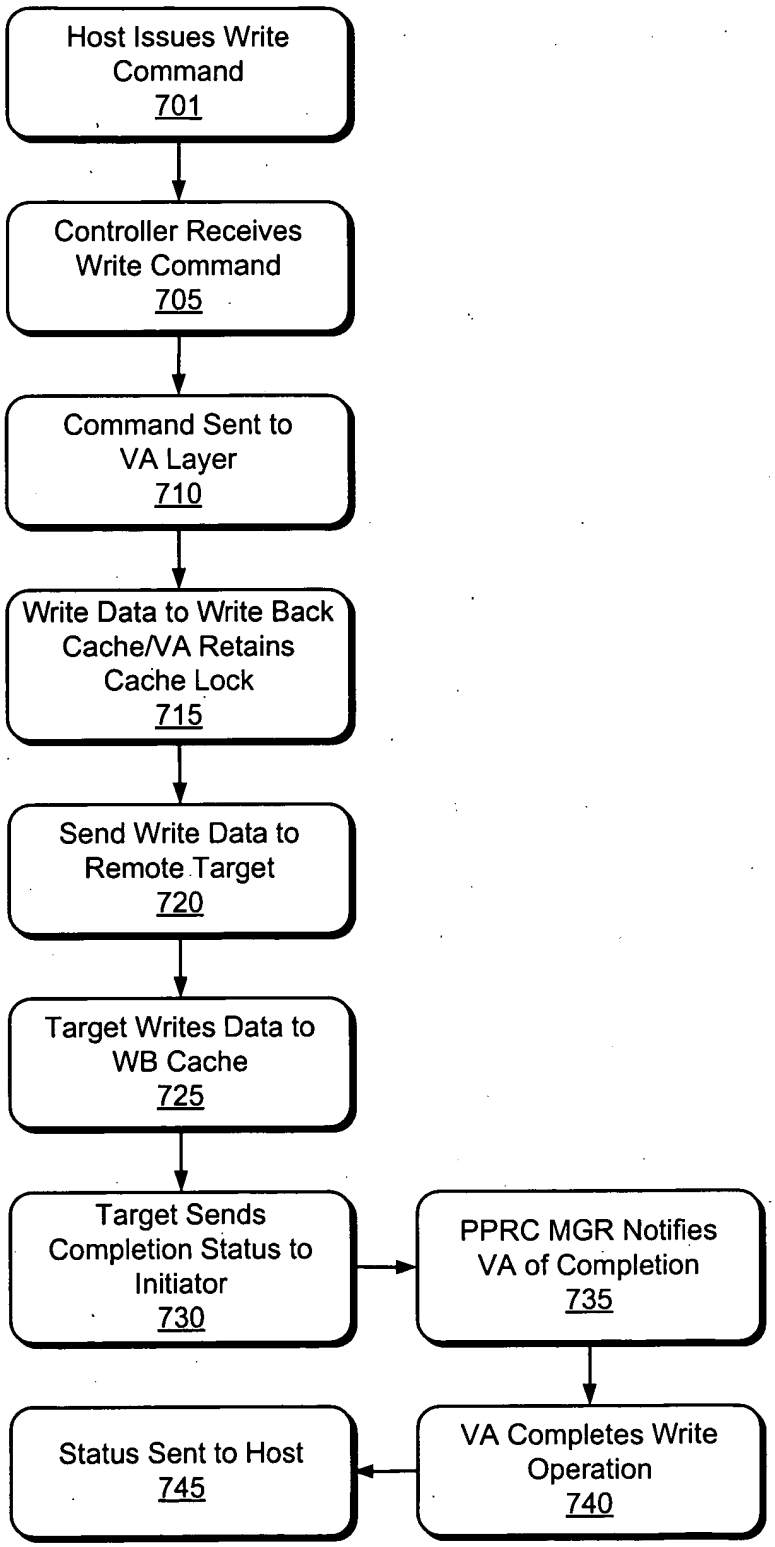

Host Issues Write Command 701
Controller Receives Write Command 705
Command Sent to VA Layer 710
Write Data to Write Back Cache/VA Retains Cache Lock 715
Send Write Data to Remote Target 720
Target Writes Data to WB Cache 725
Target Sends Completion Status to Initiator 730
PPRC MGR Notifies VA of Completion 735
VA Completes Write Operation 740
Status Sent to Host 745

Fig. 7

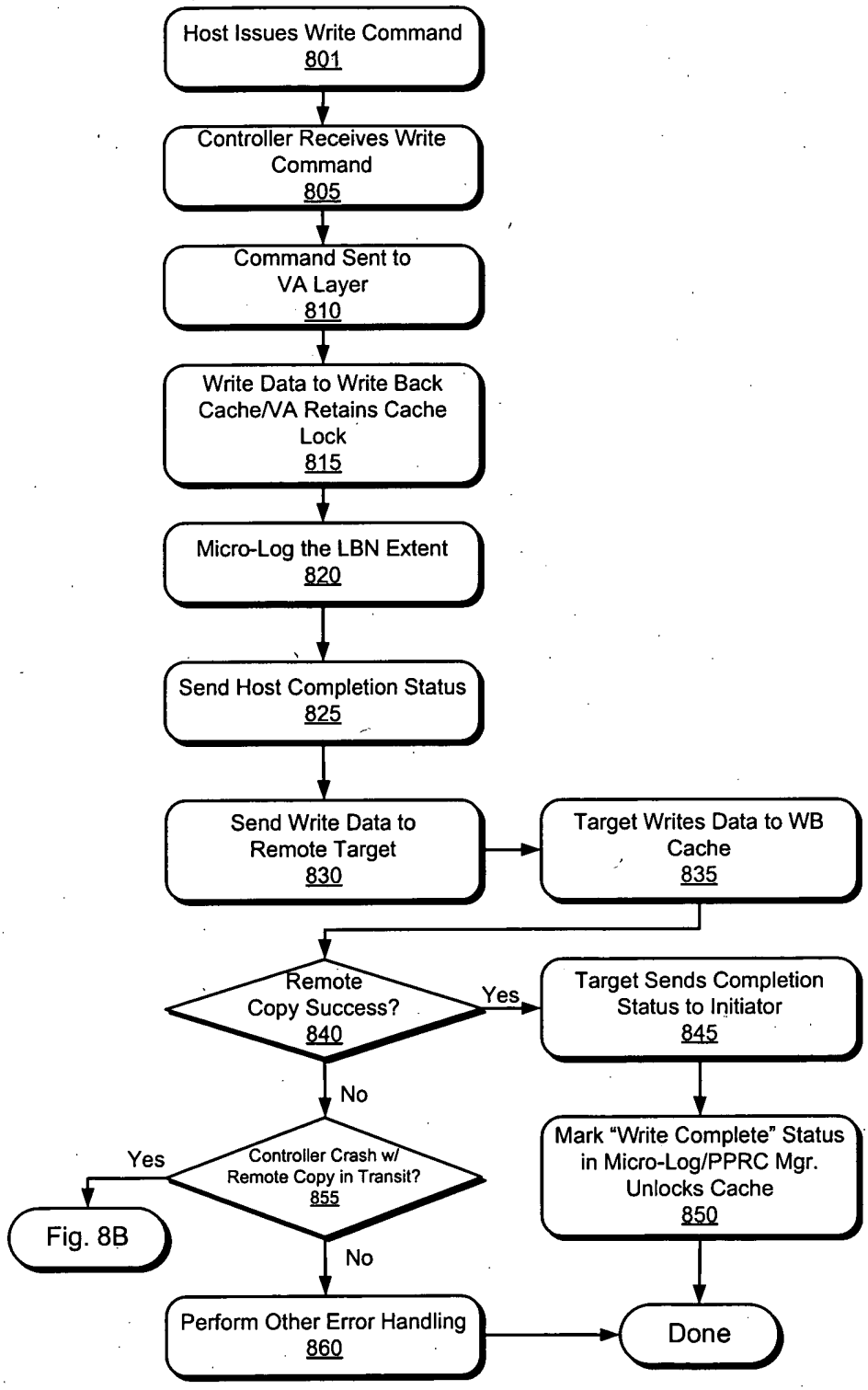

Host Issues Write Command
801
Controller Receives Write Command
805
Command Sent to VA Layer
810
Write Data to Write Back Cache/VA Retains Cache Lock
815
Micro-Log the LBN Extent
820
Send Host Completion Status
825
Send Write Data to Remote Target
830
Target Writes Data to WB Cache
835
Remote Copy Success?
840
Yes
Target Sends Completion Status to Initiator
845
No
Mark "Write Complete" Status in Micro-Log/PPRC Mgr. Unlocks Cache
850
Yes
Controller Crash w/ Remote Copy in Transit?
855
Fig. 8B
No
Perform Other Error Handling
860
Done

Fig. 8A

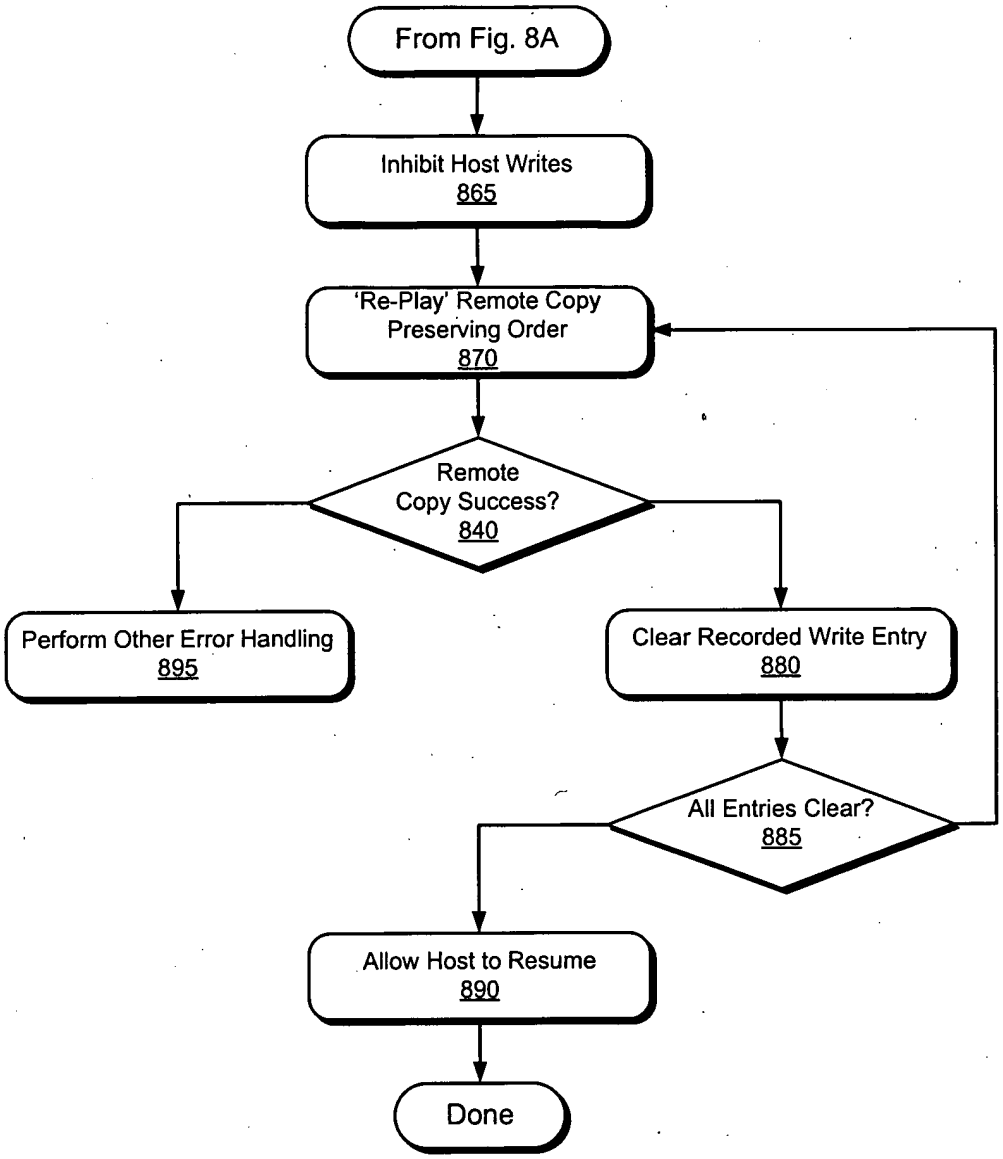

From Fig. 8A
Inhibit Host Writes
865
'Re-Play' Remote Copy
Preserving Order
870
Remote
Copy Success?
840
Perform Other Error Handling
895
Clear Recorded Write Entry
880
All Entries Clear?
885
Allow Host to Resume
890
Done

Fig. 8B

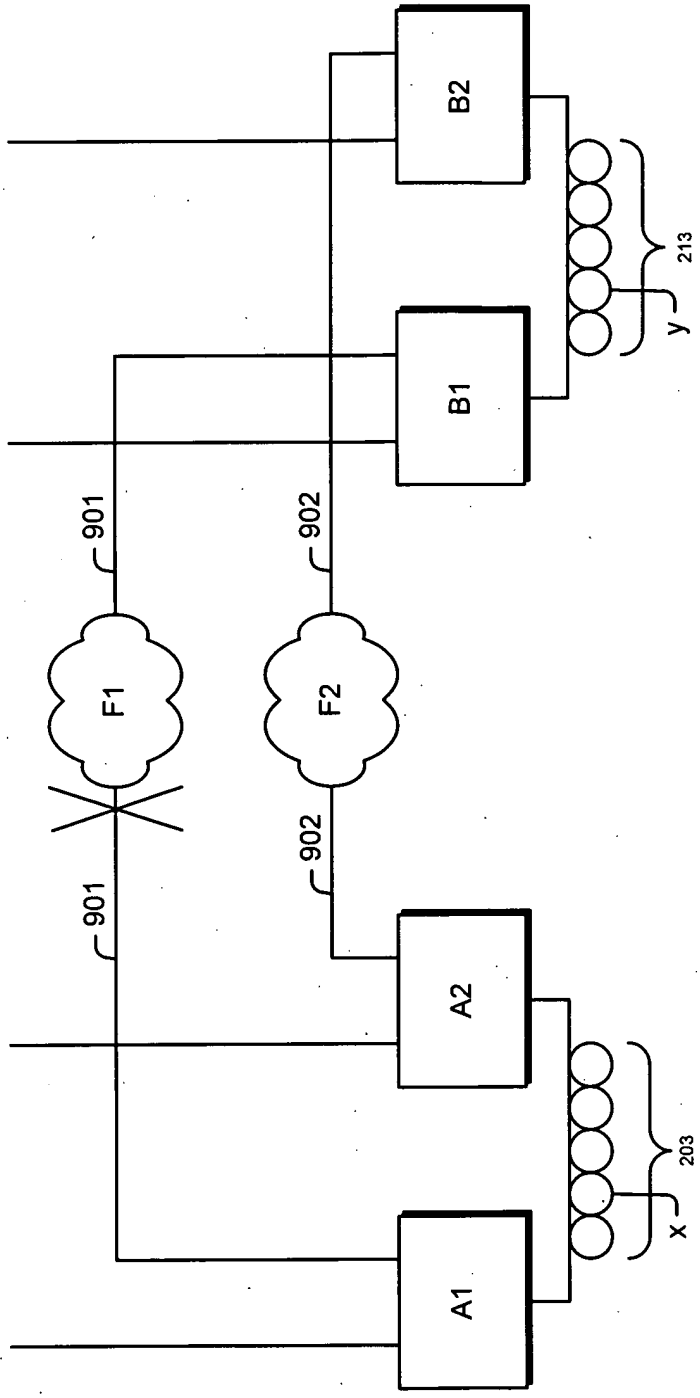
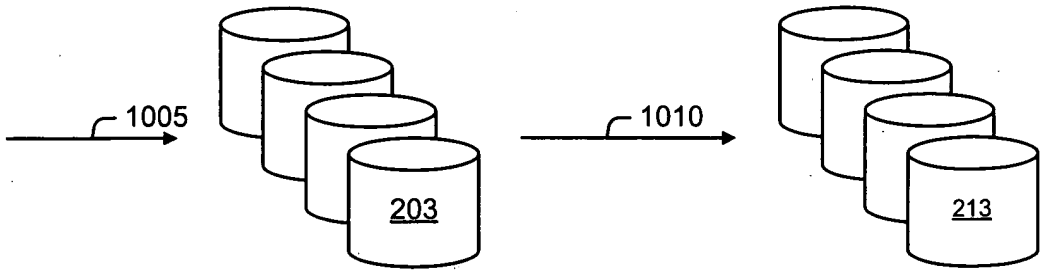


Fig. 9



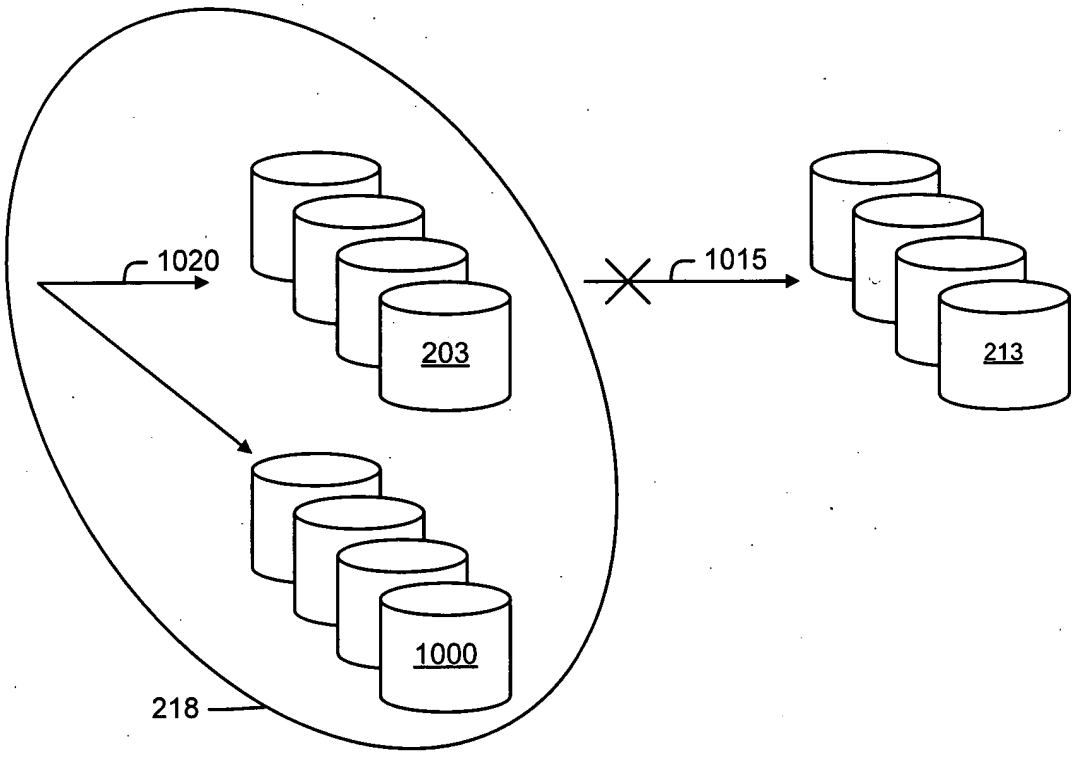


Fig. 10

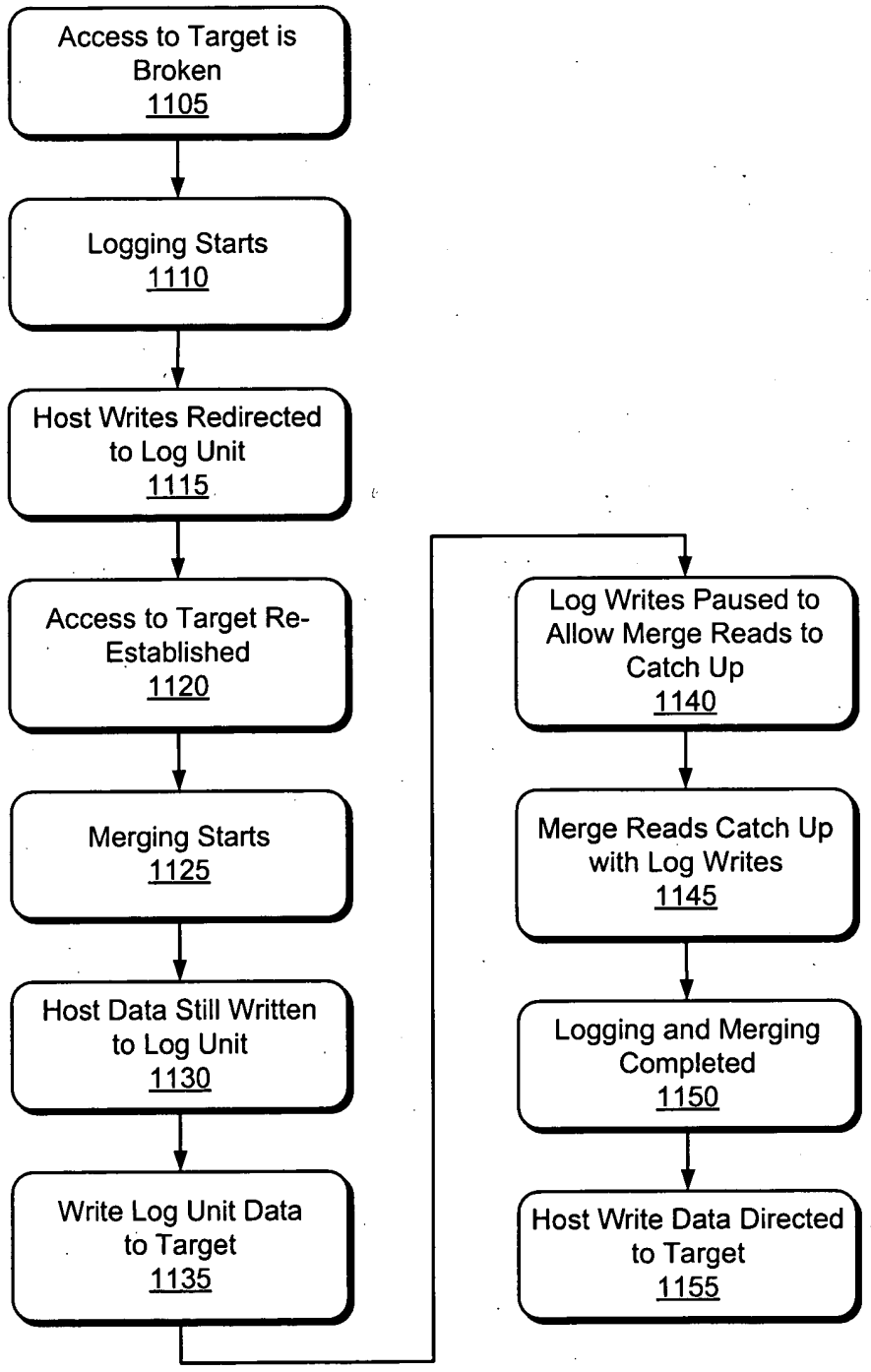

Access to Target is Broken
1105
Logging Starts
1110
Host Writes Redirected to Log Unit
1115
Access to Target Re-Established
1120
Merging Starts
1125
Host Data Still Written to Log Unit
1130
Write Log Unit Data to Target
1135
Log Writes Paused to Allow Merge Reads to Catch Up
1140
Merge Reads Catch Up with Log Writes
1145
Logging and Merging Completed
1150
Host Write Data Directed to Target
1155

Fig. 11

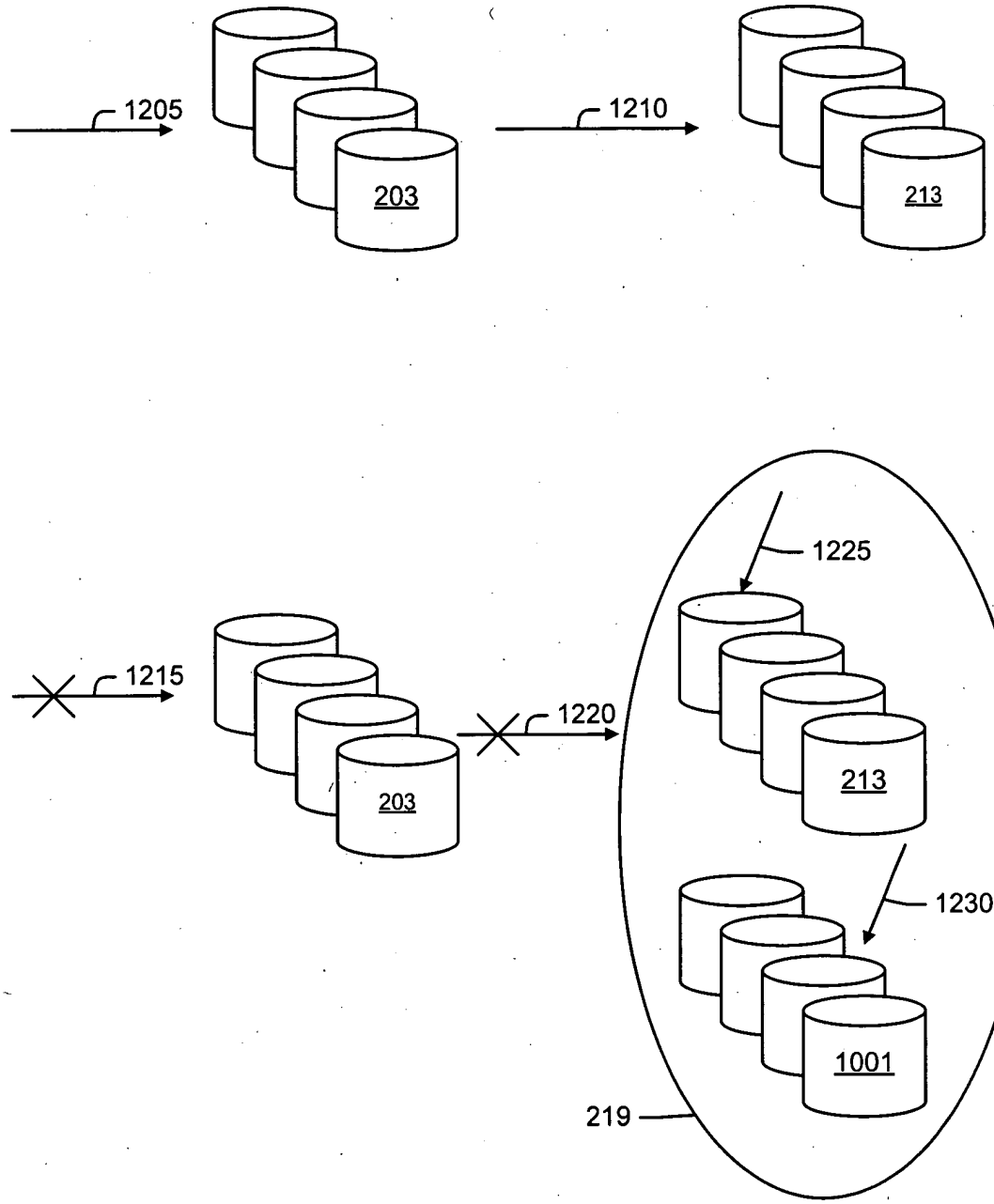


Fig. 12

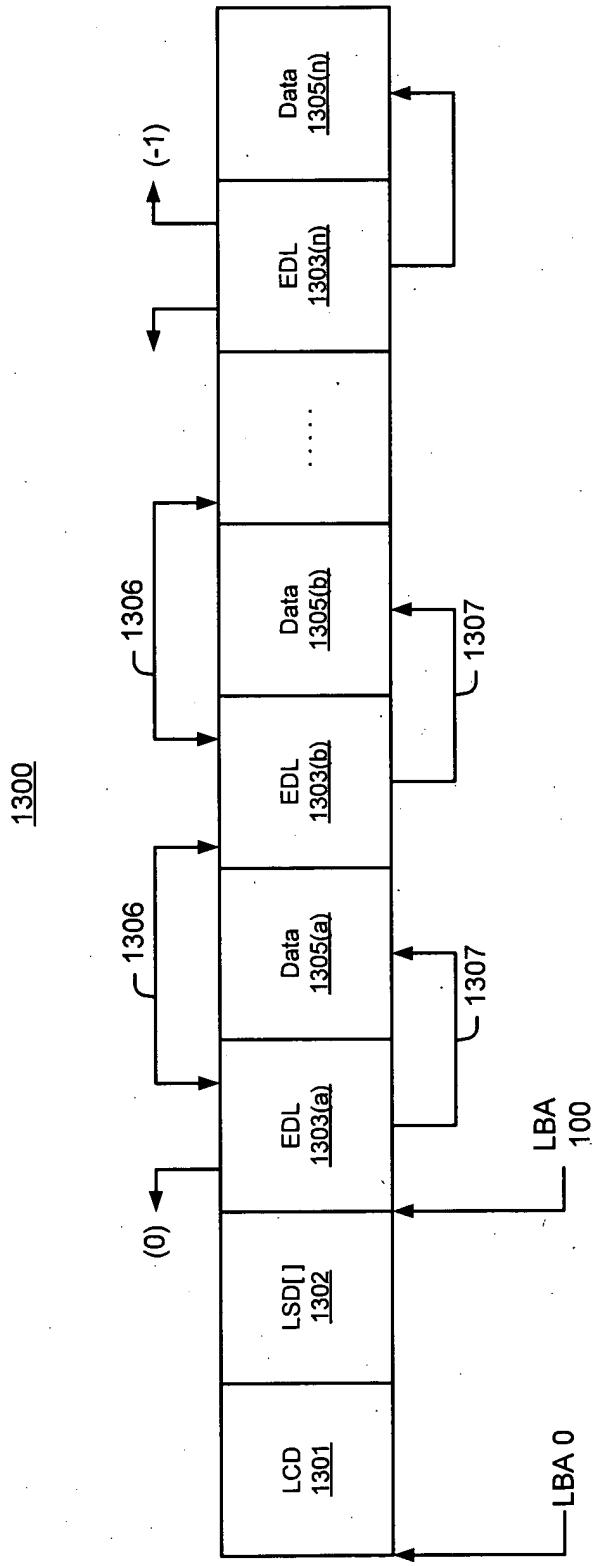

1300
LCD 1301
LSD[ ] 1302
EDL 1303(a)
Data 1305(a)
EDL 1303(b)
Data 1305(b)
.....
EDL 1303(n)
Data 1305(n)
(0)
(-1)
1306
1306
1307
1307
LBA 0
LBA 100

Fig. 13